
NAVFAC IGS-05120 (JANUARY 2003)

Supercedes IGS-05120 (05/02)
Preparing Activity: LANTNAVFACENGCOM Based on NFGS-05120X

ITALIAN GUIDE SPECIFICATIONS

Use for ITALIAN projects only

SECTION 05120

STRUCTURAL STEEL
01/03

NOTE: This guide specification is issued by the
Atlantic Division, Naval Facilities Engineering
Command for regional use in Italy.

NOTE: This guide specification covers requirements
for structural steel used in building construction.
The following publications should be reviewed for
material selection and additional specification
requirements before using this guide specification
for the following types of construction:

Highway Bridges - American Association of State
Highway and Transportation Officials (AASHTO)

Railroad Bridges - American Railway Engineering
Association (AREA)

Tower Construction - Electronic Industries
Association (EIA), RS-222-D, "Structural Standards
for Steel Antenna Towers and Antenna Supporting
Structures."

NOTE: The following information shall be shown on
the project drawings:

1. The extent and location of structural steel;
2. Designations of steel members;
3. Yield strength of steel used in design;
4. Locations where galvanized steel will be used;

5. Types of connections (welded and bolted), including adjustable runway support connections if overhead, top running cranes are provided;
6. Locations where high-strength bolts and slip critical connections are required and the loads and stresses required if design is provided by Contractor; and
7. The location of welds requiring nondestructive testing, along with the type of testing required.

Comments and suggestion on this specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1 (1998) Structural Welding Code - Steel

ITALIAN WELDING INSTITUTE (IIS)

IIS Italian Welding Institute Publications and Manuals

ITALIAN NATIONAL ASSOCIATION FOR UNIFICATION OF STANDARDS (UNI)

NOTE: A UNI Norm is a technical normative recognized as Italian Law, submitted by a private organization "Ente Nazionale Italiano di Unificazione" for Italy and is available only in the Italian language. It is the National Standard.

UNI 4633	(1960) Classification and qualification of electric welders - Welders of mild or low alloy steel pipe of 4 mm gage and over
UNI 4634	(1960) Classification and qualification of electric welders - Welders of mild or low alloy steel sheet of medium or thick gage
UNI 5132	(1974) Covered electrodes for the arc welding of unalloyed steels and Mn-low alloyed steels - General technical conditions, symbolization and methods of test
UNI 5397	(1978) Hot rolled steel finished products - Parallel broad-flanged HE beams - Dimensions and tolerances
UNI 5398	(1978) Hot rolled steel finished products - Parallel narrow-flanged IPE beams - Dimensions and tolerances
UNI 5592	(1968) Hexagon nuts - Iso metric coarse and fine thread - finish C
UNI 5679	(1973) Hot rolled steel finished products - Ipn beams - Dimensions and tolerances
UNI 5680	(1973) Hot rolled steel finished products - Upn beams - Dimensions and tolerances
UNI 5681	(1973) Hot rolled steel finished products - T sections with sharp edges - Dimensions and tolerances
UNI 5712	(1975) High-strength large hexagon bolts for structural engineering - ISO metric coarse thread
UNI 5713	(1975) High-strength large hexagon nuts for structural engineering - ISO metric coarse thread
UNI 5714	(1975) Chamfered plain washers for high-strength bolts for structural engineering
UNI 6762	(1970) Hot rolled steel structural shapes - Unequal angles with sharp edges - Dimensions and tolerances
UNI 7356	(1974) Hot rolled finished steel products - Wire rods and round bars for cold- or hot-headed bolts, nuts and rivets

UNI 7729	(1984) Plain end seamless unalloyed quality steel tubes for mechanical application
UNI 8146/A1	(1980) Non-metallic expansive agents for cement mixings - Fitness and relevant checking methods (plus amendment)
UNI 8863/FA-1	(1987/89) Unalloyed steel seamless and welded tubes suitable for screwing in accordance with UNI ISO 7/1
UNI 8993/A1	(1987) Preblended expansive mortars for grouting - Definition and classification (plus amendment)
UNI 9864	(1991) Paints and varnishes - Antirust primers drying at room temperature for steel in structures in industrial or sea environment - Requirements for the identification and the characterization
UNI 9865	(1991) Paints and varnishes - Antirust primers drying at room temperature for steel structures in mixed (industrial and sea) environment - Requirements for the identification and the characterization
UNI 9866	(1991) Paints and varnishes - Zinc-rich organic primers - Requirements for the identification and the characterization
UNI 9867	(1991) Paints and varnishes - Zinc-rich inorganic primers - Requirements for the identification and the characterization
UNI 9868	(1991) Paints and varnishes - Finishing paints drying at room temperature for steel in any environment - Requirements for the identification and the characterization
UNI 10622	(1997) Zinc-coated (galvanized) steel bars and wire rods for concrete reinforcement
UNI 11001	(1962) Code of practice for edge preparation in fusion welding of steel structures
CNR-UNI 10011	(1988) Steel structures - Instructions for design, construction, testing and maintenance

ITALIAN/EUROPEAN HARMONIZATION STANDARDS (UNI EN)(UNI ENV)(CEI EN)
(UNI EN ISO)(UNI ISO)

NOTE: A UNI EN, UNI ENV, CEI EN, UNI EN ISO or UNI ISO is a European Standard with a coincident Italian National Standard or International Standard. The two standards are identical, with most (but not all) EN's available in the English language and the UNI available only in the Italian language.

UNI EN 934-2	(2002) Admixtures for concrete, mortar and grout - Concrete admixtures - Definitions, requirements, conformity, marking and labeling
UNI EN 1011-1	(2000) Welding - Recommendations for welding of metallic materials - General guidance for arc welding
UNI ENV 1090-1	(2001) Execution of steel structures - General rules and rules for buildings
UNI EN ISO 1461	(1999) Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods
UNI EN ISO 8504-1	(2001) Preparation of steel substrates before application of paints and related products - Surface preparation methods - General principles
UNI EN ISO 8504-2	(2001) Preparation of steel substrates before application of paints and related products - Surface preparation methods - Abrasive blast-cleaning
UNI EN ISO 8504-3	(2001) Preparation of steel substrates before application of paints and related products - Surface preparation methods - Hand-and power-tool cleaning
UNI EN 10025	(1995) Hot rolled products of non-alloy structural steels - Technical delivery conditions
UNI EN 10088-2	(1997) Stainless steels - Technical delivery conditions for sheet/plate and strip for general purposes
UNI EN 10088-3	(1997) Stainless steels - Technical delivery conditions for semi-finished

	products, bars, rods, and sections for general purposes
UNI EN 10131	(1993) Cold rolled uncoated low carbon and high yeild strength steel flat products for cold forming - Tolerances on dimensions and shape
UNI EN 10137-1	(1997) Plates and wide flats made of high yeild strength steels in the quenched and tempered or precipitation hardened conditions - General delivery conditions
UNI EN 10137-2	(1997) Plates and wide flats made of high yeild strength steels in the quenched and tempered or precipitation hardened conditions - Delivery conditions for quenched and tempered steels
UNI EN 10137-3	(1997) Plates and wide flats made of high yeild strength steels in the quenched and tempered or precipitation hardened conditions - Delivery conditions for precipitation hardened steels
UNI EN 10147/A1	(2002) Continuously hot-dip zinc coated structural steel sheet and strip - Technical delivery conditions (plus amendment)
UNI EN 10152	(1994) Electrolytically zinc coated cold rolled steel flat products - Technical delivery conditions
UNI EN 10204	(1992) Metallic products - Types of inspection documents
UNI EN 10210-1	(1996) Hot finished structural hollow sections of non-alloy and fine grain structural steels - Technical delivery requirements
UNI EN 10219-1	(1999) Cold formed welded structural hollow sections of non-alloy and fine grain structural steels - Technical delivery requirements
UNI EN 10083-1	(1998) Quenched and tempered steels - Technical delivery conditions for special steels
UNI EN 10083-2	(1998) Quenched and tempered steels - Technical delivery conditions for unalloyed quality steels

UNI EN 10147	(1993) Continuously hot-dip zinc coated structural steels strip and sheet - Technical delivery conditions
UNI EN 10240	(1999) Internal and/or external protective coatings for steel tubes - Specification for hot dip galvanized coatings applied in automatic plants
UNI EN 20898-1	(1994) Mechanical properties of fasteners - Bolts, screws, and studs
UNI EN 20898-2	(1994) Mechanical properties of fasteners - Nuts with specified proof load values - coarse thread
UNI EU 58	(1980) Hot rolled flats for general purposes
UNI EU 60	(1980) Hot rolled round bars for general purposes

ITALIAN LAWS AND NORMS (D.M.)(LAW)(CIRC.)

NOTE: Italian laws and normatives are the legislative regulations and decrees issued by the Italian government in the form of laws, norms, decrees, circulars, and letters. These Laws and Decrees concur together with Norms and Standards in forming the governing directives for construction.

Law 595	(26/5/65) Technical Characteristics for Hydraulic Binders
Law 1086	(5/11/71) Technical Norms for the Discipline of Reinforced Concrete Works; Normal, Pre-Stressed and Metal Structures
D.M. 09/01/1996	Technical norms for the design, execution and testing of cast-in-place reinforced concrete, pre-cast prestressed reinforced concrete and steel structures

1.2 SYSTEM DESCRIPTION

NOTE: Consult with the structural designer.

Provide the structural steel system, including [shop primer] [galvanizing],

complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with Law 1086 and CNR-UNI 10011 except as modified in this contract.

1.4 SUBMITTALS

NOTE:

Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item is required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Recommended codes for Army projects are "RE" for Resident Engineer approval, "ED" for Engineering approval, and "AE" for Architect-Engineer approval. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Fabrication and erection drawings; G

SD-03 Product Data

Shop primer

SD-06 Test Reports

Bolts, nuts, and washers

[Welds]

Supply the certified manufacturer's mill reports which clearly show the applicable mechanical and chemical requirements together with the actual test results for the supplied fasteners.

SD-07 Certificates

Steel

Bolts, nuts, and washers

Shop primer

Welding electrodes and rods

Nonshrink grout

[Galvanizing]

Overhead, top running crane rail beam

Erection plan

Welding procedures and qualifications

1.7 QUALITY ASSURANCE

1.7.1 Drawing Requirements

Submit Fabrication and erection drawings for approval prior to fabrication.

Prepare in accordance with CNR-UNI 10011 and Law 1086. Drawings shall not be reproductions of contract drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS standard welding symbols. [Shoring and temporary bracing shall be designed and sealed by a registered professional engineer and submitted for record purposes[, with calculations,] as part of the drawings.]

1.7.2 Certifications

1.7.2.1 Overhead, Top Running Crane Rail Beam

Submit written field survey results for overhead, top running crane rail beam verifying tolerance requirements, area out of tolerance and proposed corrective measures.

1.7.2.2 Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing, and a detailed sequence of welding, including each welding procedure required.

1.7.2.3 Welding Procedures and Qualifications

UNI 4633 and UNI 4634. Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

PART 2 PRODUCTS

2.1 SOURCE MANUFACTURERS

2.1.1 Steel Shapes

The following manufacturers provide structural steel shapes and components that generally comply with these specifications:

BIT S.p.A.
31016 Cordignano
(Treviso) - Italia
Via Trieste, 33
Tel: 0438/995300
Fax: 0438/995410

CAMIP s.r.l.
Via Nazionale, 54-52010 SOCI (Ar)
Tel: (0575)560.046/560.147
Fax: (0575)560.563

NUOVA SIPRE S.p.A.
CENTRI SERVIZI ACCIAIO
Via Mediana - 37060 (Verona)
Tel: 045/6339400
Fax: 045/7930025

SICAM S.p.A.
20146 Milano
Via P. Rondoni, 1
Tel: 02-4241421
Fax: 02-47719372

2.1.2 Shop Primer

The following manufacturers provide shop primer paint that generally comply with these specifications:

COLORIFICIO PAULIN S.p.a.
S. Lucia di Seren del Grappa (BL)
Tel: 0439/44241
Fax: 0439/448028

MaxMeyer Duco
Via Comasina, 121
20161 Milano
Tel: 02-64041
Fax: 02-64042363

2.2 STEEL

NOTE: Designs requiring notch strength or
installation and operation at low temperatures will
require special material selections. Notch strength
will be required based on design geometry or for
dynamically loaded structures. In designs where the
material will be exposed to temperatures below
freezing, the material type should be checked
against the proposed ambient and working
temperatures for resistance to brittle fracture.

2.2.1 Structural Steel

Law 1086, CNR-UNI 10011, UNI EN 10025, UNI EN 10210-1, and UNI EN 10219-1.
Structural steel types [Fe 360 (Fe37)] [Fe 430 (Fe 44)] [Fe 510 (Fe 52)]
[_____]. All shapes (HE, IPE, Channels, Angles, T) shall comply with UNI
5397, UNI 5398, UNI 5679, UNI 5680, UNI 5681, UNI 6762, and UNI 7356.
Plates shall comply with UNI EU 58. Bars shall comply with UNI EU 60.

2.2.2 High-Strength Structural Steel

UNI EN 10131, UNI EN 10137-1, UNI EN 10137-2, and UNI EN 10137-3.

2.2.2.1 Low-Alloy Steel

UNI EN 10083-1 and UNI EN 10083-2 [, Grade [_____]]. plate.

2.2.2.2 Heat-Treated, Low-Alloy Steel

UNI EN 10083-1 and UNI EN 10083-2[, Grade [_____]].

[2.2.3 Weathering Structural Steel

UNI EN ISO 1461, UNI EN 10147/A1, UNI EN 10152, UNI EN 10088-2, and UNI EN
10088-3.

]2.2.3 Structural Steel Tubing

UNI 7729.

2.2.4 Steel Pipe

Steel pipe UNI 8863/FA-1, hot dip zinc coated UNI EN 10240, standard.

2.3 BOLTS, NUTS, AND WASHERS

NOTE: Commonly used bolts, nuts, and washers are listed under the applicable type of steel using the same terminology specified in "Steel" paragraph. Verify material selection with the designer and modify if required.

NOTE: Designs requiring notch strength or installation and operation at low temperatures will require special material selections. In designs where the material will be exposed to temperatures below freezing, the material type should be checked against the proposed ambient and working temperatures for resistance to brittle fracture.

Provide the following unless indicated otherwise.

2.3.1 Standard-Strength Fasteners

2.3.1.1 Standard-Strength Bolts

Standard-strength bolts shall comply with UNI EN 20898-1. The standard-strength bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type.

2.3.1.2 Standard-Strength Nuts

UNI 5592 and UNI EN 20898-2, heavy hex style, except nuts under 36 mm diameter bolts may be provided in hex style. Grade and Style for applicable bolt standard recommended.

2.3.1.3 Washer for Standard-Strength Bolts

UNI 5714 washers for standard-strength bolts.

2.3.2 High-Strength Fasteners

2.3.1.1 High-Strength Bolts

UNI 5712, Class 8.8. The high-strength bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type. High strength bolts shall comply with the requirements of D.M. 09/01/1996 or the latest updated revision.

2.3.1.2 High-Strength Nuts

UNI 5713, heavy hex style, except nuts under 36 mm diameter bolts may be provided in hex style. Grade and Style for applicable bolt standard

recommended.

2.3.1.3 Washer for High-Strength Bolts

UNI 5714 washers for UNI 5712 bolts.

2.3.4 Foundation Anchorage

2.3.4.1 Bolts

UNI EU 60, UNI 10622, or UNI 7356. Steel type Fe 360, 430, 510. Anchor bolts shall be coarse pitched threaded, consistent with UNI 5713 requirements for nuts.

2.3.4.2 Nuts

UNI EN 20898-2 or UNI 5713, hex style.

2.3.4.3 Washers

UNI 5714.

[2.3.5 Self-Locking Nuts

**NOTE: Drawings or specifications should identify
where these items are used.**

Provide nuts with a locking pin set in the nut. The locking pin shall slide along the bolt threads, and by reversing the direction of the locking pin, the nut shall be removed without damaging the nut or bolt. Provide stainless steel locking pins.

]2.4 STRUCTURAL STEEL ACCESSORIES

2.4.1 Welding Electrodes and Rods

UNI 5132 (and AWS D1.1 for reference only), and IIS.

2.4.2 Nonshrink Grout

**NOTE: Some nonshrink grouts derive their nonshrink
properties from an increase in volume of metal due
to oxidation. Where oxidation is not desired for
appearance sake, specify nonmetallic grout.**

Law 595, with no shrinkage. Ready-mixed non-shrink grout shall comply with UNI 8993/A1. [Grout shall be nonmetallic.][Non-metallic admixtures shall comply with UNI 8146/A1 and UNI EN 934-2.]

2.4.3 Welded Shear Stud Connectors

Connectors shall be made of low alloy weldable steel in accordance with UNI 7356.

2.5 SHOP PRIMER

NOTE: Shop primer specified is for structural steel located inside a typical building. For buildings that will have a lot of structural steel exposed to view inside a building (i.e. hangars, maintenance shops), exterior structural steel, or other locations that will require a better shop primer, use of a zinc rich primer and epoxy coating system is recommended.

UNI 9864, UNI 9865, UNI 9866, UNI 9867, and UNI 9868, epoxy-polyamide, green primer, except provide a suitable coating for slip critical joints. If flash rusting occurs, re-clean the surface prior to application of primer.

[2.6 GALVANIZING

NOTE: Most structural steel is painted. If galvanized items are required, they must be indicated or specified. The galvanizing specified is by the hot-dip process. This process requires large amounts of energy and unevenly heats steel sections that are either large or thick, occasionally warping the steel sections. Using zinc coating by thermal spraying (metallizing) as an alternative to hot-dip galvanizing should be considered for certain steel sections. The following American Welding Society (AWS) publications should be consulted for further information:

TS-85 - Thermal Spraying - Practice, Theories, and Application

C2.2-67 - Recommended Practices for Metallizing with Aluminum and Zinc for Protection of Iron and Steel.

UNI EN ISO 1461, UNI EN 10147, and UNI EN 10152, as applicable, unless specified otherwise galvanize after fabrication where practicable.

]2.7 OVERHEAD, TOP RUNNING CRANE RAIL

NOTE: Crane rail shape and size shall be based on the crane capacity and maximum wheel loads. Consult

the crane manufacturer for their recommended rail.

CNR-UNI 10011 and Law 1086, [_____] kg crane rail section and [bolted] [welded] joints. Provide rail fasteners and a minimum rail length of 3000 mm.

]2.8 FABRICATION

2.8.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded [or on surfaces of weathering steels that will be exposed in the completed structure]. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. [Affix embossed tags to hot-dipped galvanized members.]

2.8.2 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with CNR-UNI 10011. Do not prime steel surfaces embedded in concrete, galvanized surfaces, [surfaces to receive sprayed-on fireproofing,] [surfaces to receive epoxy coatings,] [surfaces designed as part of a composite steel concrete section,] or surfaces within 13 mm of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). Slip critical surfaces shall be primed with a suitable coating. Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 7 degrees C or over 35 degrees C; or when the primer may be exposed to temperatures below 4 degrees C within 48 hours after application, unless approved otherwise by the Contracting Officer.

2.8.2.1 Cleaning

Blast clean all steel in preparation for shop painting, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be power tool cleaned when recommended by the shop primer manufacturer. Prepare steel surface following the instructions reported in UNI EN ISO 8504-1. Blast cleaning shall be in accordance with UNI EN ISO 8504-2. Hand and/or power tool cleaning shall follow the instructions reported in UNI EN ISO 8504-3. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.8.2.2 Primer

Apply primer in accordance with manufacturer's technical instruction, except as modified herein. Apply primer to a minimum dry film thickness of 0.05 mm except provide a suitable coating for slip critical joints in accordance with the coating manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

[2.8.3 [Fireproofing] [and] [Epoxy] Coated Surfaces

Surfaces to receive [sprayed-on fireproofing] [epoxy] coatings shall be cleaned and prepared in accordance with the manufacturer's recommendations, and as specified in Section [07810, "Spray-Applied Fireproofing"] [____], ["____"].

]2.8.4 Surface Finishes

Maximum surface roughness of 125 for pin, pinholes, and sliding bearings, unless indicated otherwise.

]PART 3 EXECUTION

All installation, assembly, and erection of the structure shall be performed in accordance with UNI ENV 1090-1, unless otherwise noted herein.

3.1 INSTALLATION

[3.1.1 Overhead, Top Running Cranes

NOTE: Include paragraph for overhead, top running cranes. Underhung bridge cranes and monorail systems are normally provided with their own patented track systems and do not normally require the tight tolerances specified for overhead, top running cranes.

NOTE: Consult with the structural designer.

Runway rails and beams shall be provided in accordance with CNR-UNI 10011. In addition, provide a maximum vertical difference of 0.8 mm in the elevation between adjacent runway rail tops and adjacent runway beam tops at joints. Provide adjustable runway support connections to allow placement of the crane rails and beams to the tolerances specified. Stagger runway rail joints a minimum of 300 mm, except that the stagger shall not be the same as the crane wheel spacing.

]3.2 ERECTION

NOTE: Good design practice provides most connections and members with proper drainage. If ponding of water cannot be avoided, specify a waterproofing material to suit the job's specific needs.

Provide for drainage in structural steel. After final positioning of steel

members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.3 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with Law 1086 and CNR-UNI 10011. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt [and pin] holes. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.3.1 Standard-Strength Bolts

UNI 5592. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges. The use of standard-strength bolts in slip-critical connections is not permitted.

3.3.1 High-Strength Bolts

NOTE: The four bolt tightening methods will provide acceptable results if bolt assemblies are kept free of dirt and rust, if properly lubricated, and if proper installation procedures are followed. Because these conditions are rarely encountered during normal construction, use only direct tension indicator tightening methods where slip critical connections are required.

UNI 5712 bolts shall be fully tensioned to 70 percent of their minimum tensile strength in accordance with CNR-UNI 10011 for grade 8.8. Direct tension indicator tightening, [, or installation of alternate design fasteners,] shall be the only acceptable tightening methods. Use only direct tension indicator tightening for slip critical connections. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.4 WELDING

IIS, except use only shielded metal arc welding and low hydrogen electrodes for UNI EN 10083-1 steel. Do not stress relieve UNI EN 10083-1. [Grind exposed welds smooth as indicated.] Provide qualified welders, welding operators, and tackers. All welding shall be in accordance with UNI EN 1011-1 and UNI 11001.

3.4.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

[Removal is not required] [Remove only from finished areas].

3.5 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

[3.6 GALVANIZING REPAIR

NOTE: Most structural steel is painted. If galvanized items are required, they must be indicated or specified. The galvanizing specified is by the hot-dip process. This process requires large amounts of energy and unevenly heats steel sections that are either large or thick, occasionally warping the steel sections. Using zinc coating by thermal spraying (metallizing) as an alternative to hot-dip galvanizing should be considered for certain steel sections. The following American Welding Society (AWS) publications should be consulted for further information:

TS-85 - Thermal Spraying - Practice, Theories, and Application

C2.2-67 - Recommended Practices for Metallizing with Aluminum and Zinc for Protection of Iron and Steel.

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

]3.7 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing[, except that electric power for field tests will be furnished as set forth in Division 1]. The Contracting Officer shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.7.1 Welds

3.7.1.1 Visual Inspection

IIS. Furnish the services of welding inspectors, authorized by the Italian Public Work Ministry, for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

3.7.1.2 Nondestructive Testing

NOTE: The designer shall indicate the location of test welds and types of testing desired. The following information is presented as guidance. Dye penetrant testing detects small surface defects by enhancing the visibility of the flaw. Magnetic particle testing detects surface cracks and near-surface cracks; this test provides more information than the dye penetrant testing, and for approximately the same cost. Ultrasonic and radiographic testing detect surface and internal cracks, delaminations, lack of fusion, and density and thickness variations; these tests offer basically the same information, but their usage is limited by location and type of weld. Generally, fillet welds can only be dye penetrant or magnetic particle tested. Complete penetration welds at butt joints should be radiographically tested; all other complete penetration welds should be ultrasonically tested.

Tests shall be performed on site by a testing firm officially authorized by the Italian Public Works Ministry. The contractor shall a certificate of authorization to the Contracting Officer. Each weld inspection testing firm shall provide certification including (but not limited to) the following information:

Inspection date

Coordinate and type of welds

Method of inspection used

Code reference for testing procedure

Defects and imperfections revealed by the inspection

IIS. Test locations shall be [as indicated] [selected by the Contracting Officer]. If more than [20] [_____] percent of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the Contracting Officer. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

- a. Testing frequency: Provide the following types and number of tests:

<u>Test Type</u>	<u>Number of Tests</u>
Radiographic	[_____]
Ultrasonic	[_____]
Magnetic Particle	[_____]
Dye Penetrant	[_____]

[3.7.2 Overhead, Top Running Crane Rails and Beams

NOTE: Include paragraph for overhead, top running cranes. Underhung bridge cranes and monorail systems are normally provided with their own patented track systems and do not normally require the tight tolerances specified for overhead, top running cranes.

Runway rails and beams shall be surveyed (horizontally and vertically) after installation to verify compliance with the tolerance requirements as shown on drawings. After each survey, submit a written report to the Contracting Officer with the following information: field survey results, tolerance requirements, areas out of tolerance, and proposed corrective measures. Proposed corrective measures shall be approved by the Contracting Officer. Following completion of corrective measures, areas that were previously out of tolerance shall be re-surveyed and another written report shall be furnished to the Contracting Officer. Field surveys shall be performed and sealed by a registered land surveyor.

]3.7.3 High-Strength Bolts

3.7.3.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of [3] [_____] bolt, nut, and washer assemblies from each mill certificate batch, for each size, in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in CNR-UNI 10011. The bolt tension shall be developed by tightening the nut. A representative of the manufacturer or supplier shall be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements.

3.7.3.2 Inspection

Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension.

Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

3.7.3.3 Testing

The Government has the option to perform nondestructive tests on [5] [_____] percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the Contracting Officer. If more than [10] [_____] percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested. Retest new bolts after installation.

[3.7.4 Testing for Embrittlement

UNI EN 10147 for steel products hot-dip galvanized after fabrication.

]3.7.5 Material Strength and Chemical Composition Testing on Site and in Assembly Shop

D.M. 09/01/1996, UNI EN 10025, UNI EN 10210-1, UNI EN 10219-1. Sample collection on field shall be performed under direction of the Contracting Officer, without prior notification to the contractor.

3.7.5.1 Testing for Required Mechanical Properties

In accordance with Law 1086 and D.M. 09/01/1996, at least two specimens for each steel shape shall be tested in a laboratory officially authorized by the Italian Public Works Ministry. If steel members come from different suppliers or a different production batch, at least two specimens of each shape, for each supplier, and for each production batch shall be tested. During the erection phase, based on the size and importance of the structure, the Contracting Officer together with the design professional, will establish the number of samples to be prepared and tested in a laboratory.

Testing shall verify consistency of material properties with the minimum requirements specified in D.M. 09/01/1996 for tensile strength, yeild strength, maximum elongation, and impact resistance. With regard to tensile strength and yeild strength, each value measured shall not be less than the design strength defined in the analysis, minus the following values:

	Fe360	Fe430	Fe510
Tensile Strength (kg/cm ²)	150	180	220
Yeild Strength (kg/cm ²)	100	120	150

All steel shapes used on site shall report the identification mark of the manufacturer. Any element not reporting this mark will not be used, unless

allowed by the Contracting Officer. If samples delivered to the laboratory for testing report the identification mark, the mark shall be noted on the testing certification. If the sample is not marked, then the testing certification shall be noted "sample without manufacturer's identification mark".

3.7.5.2 Testing for Chemical Composition

At least two specimens for each supplier or production batch shall be delivered to an official laboratory to verify the percentage of metallic and non-metallic inclusions are consistent with the limits specified in UNI EN 10025, UNI EN 10210-1, and UNI EN 10219-1. Weldable steel chemical composition shall comply with recommendations of UNI 5132.

3.7.6 Factory Quality Control Tests

Material mechanical properties and chemical composition shall be periodically tested through samples prepared in factory by an official laboratory. At least two tests per year shall be performed, as per D.M. 09/01/1996. Sample collection shall be performed under the direction of a member of the exterior official laboratory, without prior notification to the manufacturer. The manufacturer shall provide continuous quality control of the production using interior laboratory testing, as required by D.M. 09/01/1996. The contractor shall submit certification of the most recent testing for both the exterior official laboratory and the interior quality control laboratory to the Contracting Officer.

3.7.7 Identification Mark

The manufacturer shall provide on each steel element supplied, an identification mark reporting manufacturer's brand name, production plant location, steel type and grade. Elements without the identification mark will not be accepted at the job site, unless otherwise directed by the Contracting Officer.

3.7.8 Documentation

Each steel delivery to the job site shall be accompanied by the following documents:

- a. Testing certificate as per UNI EN 10204
- b. Manufacturer's statement qualifying product as per D.M. 09/01/1996 and is in compliance with all requirements regarding mechanical and chemical properties

Steel deliveries without documentation will not be accepted at the job site, unless otherwise directed by the Contracting Officer.

-- End of Section --